Momentum Chapter 7 in Hecht
1-D

review - what is inertia? tendency to stay at rest or stay in straight line constant speed motion.
eg. if you are sitting on the couch eating chocolate, it's hard to get up and do work. You say you have inertia but you don't have momentum.
inertia is related to mass.

Momentum is inertia in motion.
quantity of momentum = product of mass and velocity
symbol: m is taken so p (why p? probably from pneumatics, air in motion)

$$p=mv$$

units: kgm/s sometimes it is given as Ns
it is a vector quantity (watch out, don't confuse is with kinetic energy a scalar)

Impulse: a change in the momentum

What causes changes in motion?
the net force

$F_{net}=ma$ $a=\Delta v/\Delta t$

$F_{net}=m\Delta v/\Delta t$ if m is constant, then $m\Delta v=\Delta p$

$F_{net}=\Delta p/\Delta t$ or F_{net} is the slope of p - t graph

this is the original form of newton's second law

it is valid for rocket problems and relativistic dynamics (near speed of light) unlike F=ma

impulse = $\Delta p = F_{net}\Delta t$ = area under F_{net}-t graph

units = kgm/s or Ns (kgm/s^2 x s = kgm/s)

impulse is the change in momentum caused by a force exerted through a period of time.

eg. A 0.145kg baseball is moving at 90.0 miles/hour [90.0 mile/hr(1.609 km/miles)(1000m/km)(1hr/3600s)]

90x1.609x1000/3600=40.225 m/s

determine the momentum of the ball before and after and the impulse on the ball if

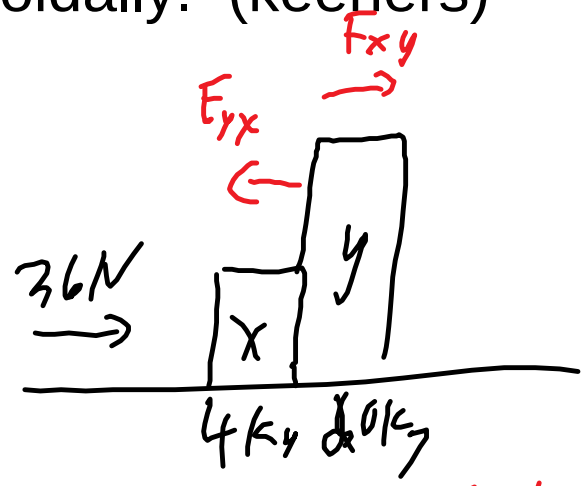
a) it goes through a window and slows to 32.0m/s?
b) it hits a wall and stops. What is the impulse on the ball and wall?
c) it is hit by a bat and goes back at -50.0 m/s. what is the impulse on the ball and bat?
d) in c, if the bat is in contact with the ball for 0.020s, what is

i)averge force on the ball?

ii) sketch F-t if F increases and decreases linearly

iii) sketch F-t if F increases and decreases sinusoidally. (keeners)

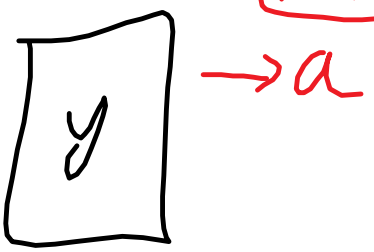
test



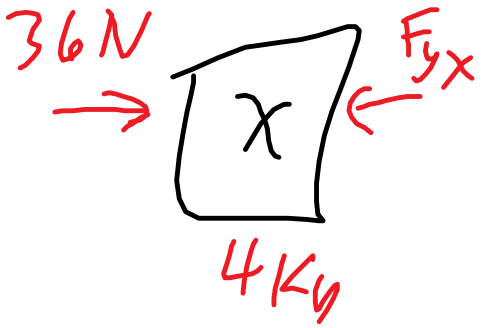
$F_{xy} = ma$

$= 20 \times 1.5$

$= 30N$



$$a = \frac{F_{net}}{m} = \frac{30N}{20+4} = 1.5 m/s^2$$



$\rightarrow a = 1.5 m/s^2$

$F_{net} = ma = \sum F = 36N - F_{yx} = 4(1.5)$

$36N = F_{yx}$